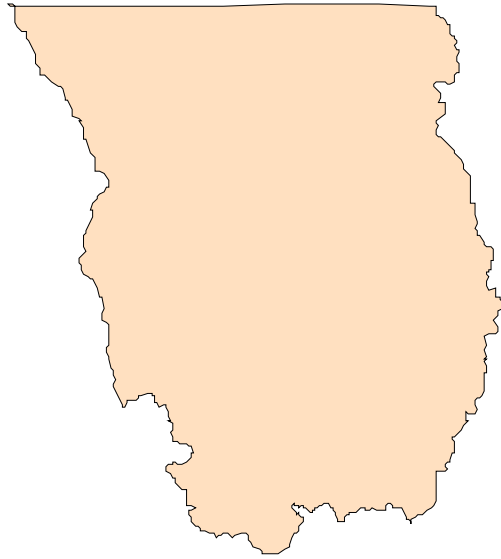


PART IV-CACHE COUNTY ANNEX RISK ASSESSMENT



General Background Information

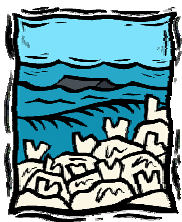
Cache County is located in extreme Northern Utah and is bordered by Box Elder County to the west and Rich County on the east. The County, covering roughly 1,165 square miles of land, is nestled between the Bear River Mountain's to the east and the divide of the Wellsville Mountains on the west. Cache Valley, a fertile agricultural area characterized by hundreds of farms and dairies, extends to the foothills of these ranges.

Cache County gained its name from the fur trading days when trappers such as Jim Bridger and Eteinne Post trapped beaver along the Bear and Logan Rivers and "cached" their pelts in large holes that they dug throughout the area. Settlement of the area began around 1855 when Brigham Young sent Mormon families to establish settlements in the valley. Since the wild grass was ideal for grazing, twenty-three men and two women were sent to Cache Valley to begin a cattle ranch on the Blacksmith Fork River. It was named Elkhorn Ranch after the antler hanging over the main gate. The plans were for 3,000 cattle to remain in the valley during the summer, and then winter further south in warmer climates. Unfortunately, the winter snows fell early that year. In a desperate attempt to save the cattle from the cold, the ranchers drove them to Box Elder County in a raging blizzard. The snow drifts were four feet deep in the valley and even deeper in the mountains. One of the rancher's feet froze and only 420 cattle survived. Within two years these ranchers left Cache Valley.

The early settlers of Elkhorn Ranch and the later Maughan's Fort weren't the first people to live in Cache Valley. Shoshoni Indians hunted and fished in "Willow Valley," as it was first called for the great willow trees that lined the stream and river banks.

In the early 1900's the fertile soil in Cache Valley attracted further settlement and soon transformed the valley into a major agricultural center for farming and ranching. Today, agriculture is still a viable part of Cache County's economy as evidenced by numerous farms, ranches, and dairy operations along with cheese factories and beef and pork processing plants. Utah State University located in Logan City has long been a significant part of the valley's economy and continues to grow as a major research university and area employer. Recent economic development includes several light manufacturing firms that have increased employment opportunities and a growing tourism industry which takes advantage of the County's countless scenic and outdoor recreation opportunities. (See the "Population Density and "Land Ownership" map in the map section of the county annex)

Table IV-28: Cache County Participating PDM Jurisdictions			
Cache County	Amalga Town	Clarkston Town	Cornish Town
Hyde Park City	Hyrum City	Lewiston City	Logan City
Mendon City	Millville City	Newton Town	Nibley City
North Logan City	Paradise Town	Providence City	Richmond City
River Heights City	Smithfield City	Trenton Town	Wellsville City



CACHE COUNTY FLOODING

Background

Portions of Cache County are at threat from both riverine and flash flooding. The Cache Valley (the western part of Cache County where nearly all the county's population is located) is located in the Bear River Drainage basin. The Bear River flows through the valley. The two main tributaries of the Bear River located in Cache County are the Logan and Blacksmith Fork Rivers. The Logan River is the largest tributary of the Bear. Other tributaries of the Bear that generally enter the valley through canyons of the mountainous eastern part of the county are the Summit Creek, Little Bear, Spring Creek, Cherry Creek, High Creek and the Cub River. All of these streams and rivers, to some degree, have had some history of flooding.

Phase II of the National Pollutant Discharge Elimination System (NPDES) administered by EPA has requirements for communities to more carefully manage their storm water discharge. While driven more by water quality concerns, nonetheless this provides an important opportunity for communities to better manage their storm water systems. This is critically important because for many communities an ever increasing threat to residents comes from the potential for man-made canal failure flooding. As more development has occurred, existing irrigation canals have been increasingly relied on to accommodate storm water discharge. Irrigation officials are quick to point out that the canals were never designed for such use. Most canals have lower capacities and a narrowing channel the further you go down the canal. While this design makes sense for irrigation use, it is exactly the opposite of how you would design a canal to accommodate storm water discharge. The positions of many canals in Cache County also make them susceptible to blockage by debris or ice that can result in canal failure outflows. Cache County has had a couple of near misses in this regard.

In terms of potential damage to developed residential, commercial and industrial areas, the Logan & Blacksmith Fork Rivers poses the most significant threat for residents of Cache County. Both of these rivers drain large areas and have steep well defined stream channels. Flood level flows are produced when high temperatures occur during the early spring and accelerate the watershed snowmelt rate. Often this threat can be escalated when combined with early spring rains.

A number of dams are located on the Logan River in the canyon upstream of the City of Logan. Due to their relatively small size, they do little to moderate flood potential for downstream development.

The Bear River enters Cache County on the north near Preston Idaho. Winding through the valley it eventually enters the Cutler Reservoir. The risk from rising flood waters of the Bear River through Cache County is relatively minor. Land located in the Bear River flood plain has a high water table which makes development difficult. Most of adjacent land near the Bear is used for agricultural purposes. Farmers and ranchers have seemingly adapted their agricultural activities to mitigate the cyclical high flows effects of the Bear River. Much of the adjacent agricultural uses along the Bear are operated under lease agreements with Pacificorp who owns

most of Cutler Reservoir. See the “FEMA Flood Zone” Map in the county annex map section.

History of Flooding in Cache County

In terms of historical flooding impact on development, most events have been documented on streams and rivers that drain the mountainous eastern portion of Cache County and flow into western Cache Valley. Most of the significant flooding that has historically impacted developed land has occurred on the Logan and Blacksmith Fork Rivers. However, noteworthy flooding has occurred on some of the smaller streams and creeks that enter the valley near the towns of Providence, Smithfield and Richmond.

Table IV-29: Cache County Flood History 1847-2003

Location	Date	Description
Amalga	1980	No information available
Clarkston	1917	No information available
	Aug 1958	Crop damage, road damage
	Aug 1961	Crop & road damage, flooded homes
	1980, 1981	No information available
Hyde Park City	1993	Lower Canal failure, home flooded and property damage.
Logan	1882	No information available
	May 1907	Logan River flooding, basements of homes near river flooded. Most flooding in Logan’s recorded history.
	May 1957	Agricultural flooding in lower fields
	May 1958	Crop and road damage
	July 1962	Crop damage
	Sept 1963	Road damage
	June 1964	Crop damage, 2 inches rain in 24 hours
	1969	No information available
	1971	Low lying farms flooded, stream banks eroded, basements flooded.
	1972, 1976	No information available
	1977	Dry Canyon Flooding
	1978, 1980, 1981	No information available
	Spring 1983	Several bridges destroyed, undercutting of embankments, Canyon Road Landslide, culverts and roads.
	Aug 1997	Dry Canyon flash flooding
	1998	Flooding on the Blacksmith Fork River backed up Spring Creek and property damage occurred.
Providence	Aug 1959	Cloudburst flooding of dozens of homes near Spring Creek.

Table IV-29: Cache County Flood History 1847-2003		
Location	Date	Description
Smithfield	June 1964	A number of homes flooded by Summit Creek after intense storm
FEMA Flood insurance study for Logan City, 2-17-81, Local Surveys (see appendix A) (Butler & Marsell, 1972), (Division of Comprehensive Emergency Management, 1981)		

Cache County Flood Hazard Assessment

Hazard Profile

Frequency	Some flooding occurs nearly every year in Cache County
Severity	Moderate
Location	Generally along rivers, streams and canals.
Seasonal Pattern	Spring flooding as a result of snowmelt. Mid-late summer cloudburst events.
Duration	A few hours or up to three weeks for snowmelt flooding
Speed of Onset	1-6 hours
Probability of Future Occurrences	High-for delineated flood plains there is a 1% chance of flooding in any given year.

Isolated flooding has been fairly common for many years. Damage from flooding has been relatively minor. The majority of flooding in Cache County has occurred on agricultural land.

Following a development pattern not unlike many Utah and western communities, many early European settlements in Cache County were located near the mouths of canyons. Early settlers located there for easy access to water that could be diverted for irrigation of crops and pastures as well as fertile soils well suited for agriculture. Richmond, Smithfield, Logan, Providence Millville and Hyrum are all located near the mouths of canyons that drain some portion of the adjacent Bear River Range. The Logan River has the largest drainage basin next to the Bear at 524 square miles. The Blacksmith Fork drainage basin is the next largest at roughly 287 square miles.

Analysis of areas of Cache County mapped by FEMA for communities that participate in the NFIP indicate some conflict related to existing development located in what has been determined to be the 100 year floodplain. Digitized floodplain maps for Cache County were overlaid on a layer of Digital Ortho Aerial Photographs as well as a 1996 data layer that delineates “developed” areas (Water Related Land use Study produced for the State of Utah Division of Water Resources). An August 2003 report Flood Hazard Identification Study: Bear River Association of Governments by the U.S. Army Corps of Engineers was also used to determine flood risk for communities that do not have FEMA Firm flood plain maps.

Hyde Park City has a number of existing homes located in the 100 year flood plain along the stream that drains Hyde Park Canyon. In addition, development near the Logan North field and Hyde Park Canals is at potential risk of flooding. The recently completed Cache County Storm Water Analysis report concluded that these canals through Hyde Park have deficient capacity to

carry predicted flows resulting from a 10 year storm event of 3 hour duration. The problem areas predicted by this model were where the canal intersects 200 South, Center Street and 300 North in Hyde Park City (JUB Engineering, 2003).

In terms of the relative hazard from flooding, older residential development along the Logan River in the lower portions of **Logan City** commonly referred to as the “Island” area represents one of the most significant threat in Cache County both in terms of potential loss of risk and property loss. A number of older homes are located in the 100 year floodplain of the Logan River. In addition a number of newer (post 1970) homes have been constructed near the river in the flood plain (along Sumac and Thrushwood Drives).

A number of homes in the Country Manor Subdivision along the Blacksmith Fork River are located in the 100 year floodplain. The Logan City Golf Course is also located in the 100 year floodplain. The golf course can accommodate flooding and flood water storage device and is designed to moderate flooding downstream.

A number of canals make their way through Logan City. Potential for failure is significant for all canals. If storm water management is not properly addressed, the risk to life and property near canals increases as more development puts further demands on systems beyond their designed capabilities. According to a canal company representative, the Northwest Field/Benson Canal experiences difficulty accommodating demand with any storm event that totals ½ inch of precipitation in one hour. The canal has a permitted flow rate of 40.3 cfs and a calculated capacity of 60 cfs. The canal has potential to pick up 363 cfs in predicted storm water flows when measured near the airport (City of Logan, 2001).

In May 1996 the Logan and Northern Canal failed above Crockett Avenue pump house. City officials were forced to divert flows down Crockett Avenue into the Logan River to prevent damage to adjacent residences (City of Logan, 2001).

A large portion of lower **Mendon Town** is mapped in the 100 year flood plain. Small streams that drain a portion of the eastern slope of the Wellsville Mountains flow through Mendon. Two steep drainages converge from Bird Canyon and Coldwater Canyon.

Perhaps a larger issue that poses a more acute flooding threat for Mendon inhabitants comes from the town’s proximity to the Wellsville-Mendon Canal. Mendon is located on the lower stretches of the canal that begins at Hyrum Dam. The canal runs North-South uphill of Mendon Town. Site specific flood problems have occurred with this canal. Overtopping and bank erosion occurred in 1982. Flooding problems occurred when heavy rain fell on frozen ground.

The Lower Millville Providence Canal was demonstrated to have deficient capacities to accommodate a 10 year, 3 hour duration storm event as if flows though **Millville City** when it was modeled for the Cache County Storm Water Analysis report. Channel capacity was found to be deficient at 50 North, 150 North, 400 North and 2200 South in Millville City.

Likewise the Lower Millville Providence Canal produces similar issues as it flows though **Providence City**. The model suggest that capacity deficiency exist as the canal nears 500 South, 400 South, 200 South, 100 South and 100 North (JUB Engineering, 2003).

Residential development in **Smithfield City** along Summit Creek is also threatened by significant flooding along Summit Creek according to mapping (See Cache County Flood Plain Map). However, in post settlement history the impacts to Smithfield residence have been minimal from Summit Creek. During the 1983 flooding that impacted nearly the whole state; Smithfield did experience some rising flow in Summit Creek that were contained by sandbagging.

The Logan Northern Canal flows through much of Smithfield City. Although minimal property damage has occurred, the canal has some sections that have been problematic and vulnerable to bank overflow. Most of the problems are associated with debris accumulation and/or storm surge water levels. Problem areas include areas around 4th South and about 4th East, 1st South to Center Street and 50th East, 3rd to 4th North and 50th West. During the 1983 floods, a large debris flow almost reached the Logan, Hyde Park and Smithfield Canal. Had the canal be blocked significant flooding would have occurred.

The Cache County Storm Water Analysis Report concluded that the Logan, Hyde Park & Smithfield Canal as it passes though Smithfield City is deficient in capacity to accommodate a 10 year storm event of 3 hour duration. The report modeled such a storm event and analyzed drainage capacity of the canal. Potential problem areas were identified where the canal intersects 600 South, 400 South, 200 South, and 200 North in Smithfield (overtopping near 200 North would cause minor damage because it would flow onto the Smithfield Golf Course). Further the Logan Northern Canal was found deficient as it intersects 300 South, 200 East and Center Street in Smithfield City (JUB Engineering, 2003).

Lower portions of **Richmond City** are located in the 100 year flood plain. The flood threat comes from City Creek, a small tributary that drains a portion of the rather steep mountains to the east of Richmond City. Even though a large portion of the city is identified as in the 100 year flood plain, historically no significant flooding has occurred on City Creek. A large portion of the stream flow can be diverted into an irrigation canal above Richmond City. This may act to moderate the impacts of high stream flows.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-30: Cache County Flooding Residential and Commercial					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk	
		Units	Value	Units	Income*/Structures**
Amalga Town	Incomplete data-No flood plain map				
Clarkston Town	23	9	\$836,787		
Cornish Town	Incomplete data-No flood plain map				
Hyde Park City	31	7	\$1,044,463		
Logan City	160	54	\$8,091,198	10	\$47,800/\$5,057

Table IV-30: Cache County Flooding Residential and Commercial					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk	
		Units	Value	Units	Income*/Structures**
Mendon City	75	22	\$3,831,634	1	\$1,900/\$505
North Logan City	23	8	\$1,151,007		
Providence City	7	4	\$473,631		
Richmond City	104	34	\$4,077,484		
River Heights City	Incomplete data-No flood plain map				
Smithfield City	590	150	\$22,060,742	13	\$10,300/\$6,574
Trenton Town	Incomplete data-No flood plain map				
Wellsville City	100	30	\$4,076,888	3	\$2,300/\$1,517
Unincorporated	913	277	\$38,662,627	11	\$5,900/\$5,563
Population and Residential Development estimates are derived using 2000 Census data					
*2002 estimated total sales revenue (Census)					
** Based on average 2002 assessed commercial building value for Cache County					
(2002 State Tax Commission Report & Cache County Assessor's Office)					
Note: Communities not listed have no residential or commercial property identified in the hazard.					
No data was available to analyze the extent and magnitude of potential canal flooding					

Table IV-31: Cache County Flooding Other Facilities at Risk				
Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Amalga Town		.1 miles\ \$310,000		
Clarkston Town		.2miles\ \$620,000		
Hyde Park City		.3miles\ \$930,000		
Lewiston City		.8miles\ \$2,480,000		.05miles/\$12,056
Logan City		1.5miles\ \$4,650,000		.19miles/\$45,815
Mendon City		1.1miles\ \$3,410,000		
Millville City		.1miles\ \$310,000		
North Logan City		.5miles\ \$1,550,000		
Richmond City		.9miles\ \$2,790,000		.05miles/\$12,056
River Heights City				
Smithfield City		3.6miles\ \$11,160,000		.13miles/\$31,347
Wellsville City	Willow Valley Middle	2.1miles\ \$6,510,000		.09miles/\$21,702
Unincorporated		26 miles two lane roads/\$82,150,000 .3 miles 4 lane highway/\$1,650,000		.93miles/\$224,255
See Appendix D for data sources and cost factors.				
Note: Jurisdictions not listed have no identified facilities at risk.				

Assessing Vulnerability: Analyzing Development Trends

Many of the municipalities in Cache County do not have adequate ordinances or regulations in place to restrict development in flood prone areas. Development pressure in flood prone areas intensifies as more development occurs and new development is pushed to marginal areas. This is especially true with the cities in the Logan Urbanized Area.

Development is occurring near the numerous irrigation canals. This is to be expected. Canals cut through most communities and are difficult if not impossible to avoid. This is not necessarily a problem. Properly designed and utilized canals are not a flood risk necessarily. The problem is they were designed to transport irrigation water; not storm water. As development occurs in the sub basins near canals, the dramatically increased runoff generated by the added impervious surface area has to go somewhere. A great deal of this urban runoff ends up in the canals.

Existing storm water management systems in many cities rely on these canals to accommodate storm water flows. Many of these canal systems are at capacity for storms of near normal precipitation. Higher than normal storms will put demands on the canal systems that they cannot accommodate. Some problems have already occurred and many more are likely to happen if jurisdictions do not get a handle on alternative methods of storm water management. The most reasonable approach is to require all new development to accommodate its own storm water on-site.

In many circumstances the communities that are at risk from overtopping canals are not necessarily the ones creating the problem. Often canals will flow through one or more communities. It's generally the one farthest downstream that sees the problem. The upstream communities may be the ones generating the most stormwater outflows into the canal but it's the ones at the end of the system that is more likely to get flooded. The solution must include regional cooperation.



CACHE COUNTY WILDFIRES

Background

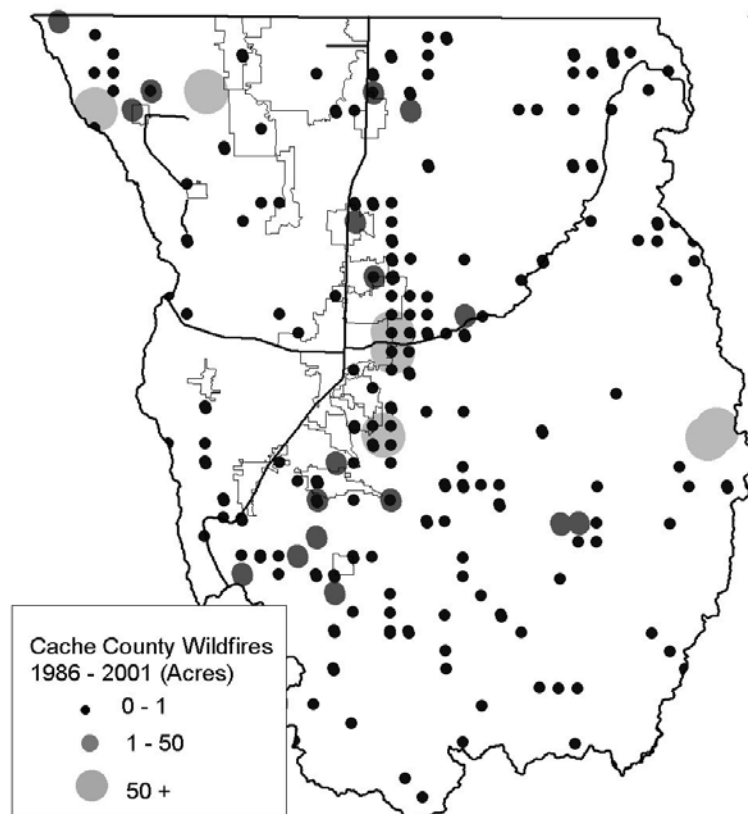
Wildfire has always had an impact on Cache County inhabitants. A few years ago many Logan City residents watched as wildfire crept down the hillside east of the city. Luckily little property damage resulted. To a certain extent, living with wildfires will always be a part living in Cache County.

Many of the communities in Cache County are located along the base of the Bear River Mountains in Cache Valley. Paradise, Millville, Providence, River Heights Logan, North Logan, Hyde Park City and Richmond all have urban interface or potential urban interface with wildfire high risk areas. Wellsville and Mendon on the east side of the valley have potential wildfire-urban conflict for development along the base of the Wellsville Mountains. **See the “Wildfire Hazard” Map in the county annex map section.**

In addition a number of cabins are located on private in-holdings or long term leases in the Cache National Forest.

History of Wildfires in Cache County

The following graphic illustrates the number and rough locations of wild fires in Cache County in the 15 year period from 1986 to 2001.



Cache County Wildfire Hazard Assessment Hazard Profile

Frequency	Annually (to some extent)
Severity	Severe
Location	Mostly along the Bear River Mountains east of Cache Valley or the Wellsville Mountains west of Cache Valley.
Seasonal Pattern	Generally the worst from early July to mid September (depends on drought conditions)
Duration	A few hours to two weeks
Speed of Onset	1-12 hours
Probability of Future Occurrences	High (Based on data from 1986-2001, there is a 24% chance a fire of at least 1000 acres will occur every year)

Logan City is the most urbanized community in the district. Largely “built-out”, a significant amount of recent development has occurred on the eastern side of the city. Much of this development is characterized as upscale and many homes are located on the urban-wild land interface. Electrical power lines for Logan City located on the eastern margin can start wild land fires due to electrical shorts.

In **Unincorporated Cache County**, the Scare Canyon and Hardware Park developments in South East Cache County have about 120 cabins and a large number of developable lots. About 38 cabins are located in Logan Canyon along U.S. 89 many in the Birch Glen area.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-32: Cache County Wildfire Risk Residential and Commercial					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Logan City	172	50	\$9,582,954	3	\$2,500/\$1,517
Millville City	217	53	\$7,823,708	10	\$7,000/\$5,057
Providence City	15	5	\$111,586		
Unincorporated	340	95	\$13,871,710		
	329	103 cabins	\$12,360,000		
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor's Office) Note: Communities not listed have no residential or commercial property identified in the hazard.					

Table IV-33: Cache County Wildfires Other Facilities at Risk				
Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
North Logan City			0.4miles/\$19,177	
Unincorporated			1.9miles/\$91,75	.93miles/\$224,256
See Appendix D for data sources and cost factors. Note: Jurisdictions not listed have no identified facilities at risk.				

Assessing Vulnerability: Analyzing Development Trends

The areas that expose development to the most risk from wildfires are often the most desirable places to live. These places afford residents good views, access to public lands, open space and a connection with nature. Most jurisdictions have found it difficult to restrict, limit or modify development proposals for these areas.

The population of Cache County by 2050 is projected to nearly double. For communities to accommodate roughly 100,000 new residents, development pressures will certainly increase in fire prone areas. Increased encroachment on the wild land margins of communities will undoubtedly occur. It has already occurred in Logan City. North Logan and to some extent Hyde Park are beginning to trend this way as well.



CACHE COUNTY LANDSLIDES

Background

Landslide occurrences are common for portions of Cache County. The most frequent problems are associated with debris flows on alluvial fans in many of the canyon drainages. See the “**Landslide Potential**” Map in the county annex map section.

History of Landslides in Cache County

Table IV-34: Cache County Landslide Areas	
Active Landslides (in Acres)	Historically Active Landslides 1847 to present (in Acres)
160	97,731

During the wet years of 1982 & 1983 an abnormally high numbers of landslides occurred in Cache County. A rather large land mass slid into the Porcupine Reservoir upstream of the right abutment. A slide near Nibley Road east of Hyrum occurred in the back yard of a residential home. A slide on College Hill below Utah State University blocked the Logan and Northern Irrigation Canal causing some limited flooding. The road up Millville Canyon was displaced 4 feet by a slide. A debris flow from Dry Creek above Smithfield reached the Logan, Hyde Park and Smithfield Canal (south of 300 South).

Cache County Landslide Hazard Assessment Hazard Profile

Frequency	Periodic
Severity	Moderate
Location	Generally located in areas with steeper slopes. Debris flows mostly occur at the mouth of canyon drainages.
Seasonal Pattern	Generally the worst in the wetter spring months.
Duration	Up to two weeks
Speed of Onset	No warning
Probability of Future Occurrences	High

Debris flows present a significant threat for development located in the mouths of the many steep canyons located in Cache County. The dynamics of this threat changes depending on the upslope drainage conditions. Wildfire that removes sediment stabilizing vegetation can dramatically increase the risk of debris flows. The other indirect threat comes from canal flooding caused by debris flow blockage.

Accurate spatial data is lacking that defines the extent of the debris flow threat in canyon areas. However areas of concern include the historic alluvial fans of Logan Canyon, Logan Dry Canyon (has been mitigated by a recently constructed debris basin), Green Canyon, Millville Canyon, Providence Canyon, Blacksmith Fork Canyon, Smithfield and Cherry Creek Canyons.

Some portions of the lower “Island” area in Logan are located near active landslide areas. Landslides on these Lake Bonneville sediments are fairly common.

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-35: Cache County Landslide Risk Residential and Commercial (Active Landslides Only)					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Logan City	100	33	\$5,464,538		
Unincorporated	3	1	\$75,693		
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor’s Office) Note: Communities not listed have no residential or commercial property identified in the hazard. Data does not include areas susceptible to debris flows (no data available)					

Table IV-36: Cache County Landslides Other Facilities at Risk (Active Landslides Only)				
Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Logan City		.3 miles/\$930,000		
See Appendix D for data sources and cost factors. Note: Jurisdictions not listed have no identified facilities at risk.				

Table IV-37: Cache County Landslide Risk Residential and Commercial (Active & Historically Active Landslides)					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Hyrum City	47	10	\$1,223,044		
Logan City	3,775	1,207	\$125,675,961	9	\$47,300/\$4,551
Providence City	50	15	\$3,174,217		
Unincorporated	286	75	\$13,806,238	24	\$20,200/\$12,137
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor’s Office) Note: Communities not listed have no residential or commercial property identified in the hazard. Data does not include areas susceptible to debris flows (no data available)					

Table IV-38: Cache County Landslides Other Facilities at Risk (Active & Historically Active Landslides)				
Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Hyrum City		1.2miles/\$3,720,000		
Logan City		16.9miles/\$52,390,000		
Millville City		0.1miles/\$310,000		
North Logan City			0.1miles/\$4,793	
Providence City		0.7miles/\$2,170,000		
Trenton Town		0.2miles/\$620,000		
Unincorporated		7.1miles/\$2,201,000	0.1miles 345Kv line/\$4,821 1.7miles 138Kv line/\$81,488	.92miles./\$221,844
See Appendix D for data sources and cost factors. Note: Jurisdictions not listed have no identified facilities at risk. Data does not include areas susceptible to debris flows (no data available)				

Assessing Vulnerability: Analyzing Development Trends

Increasing development occurring in the mouths of canyons along the Bear River Range should be of critical concern to local land use officials. Logan Canyon and Dry Canyon already have significant development. Increasing development pressure will be on Green Canyon above rapidly growing North Logan and to a lesser extent Providence and Millville Canyons.

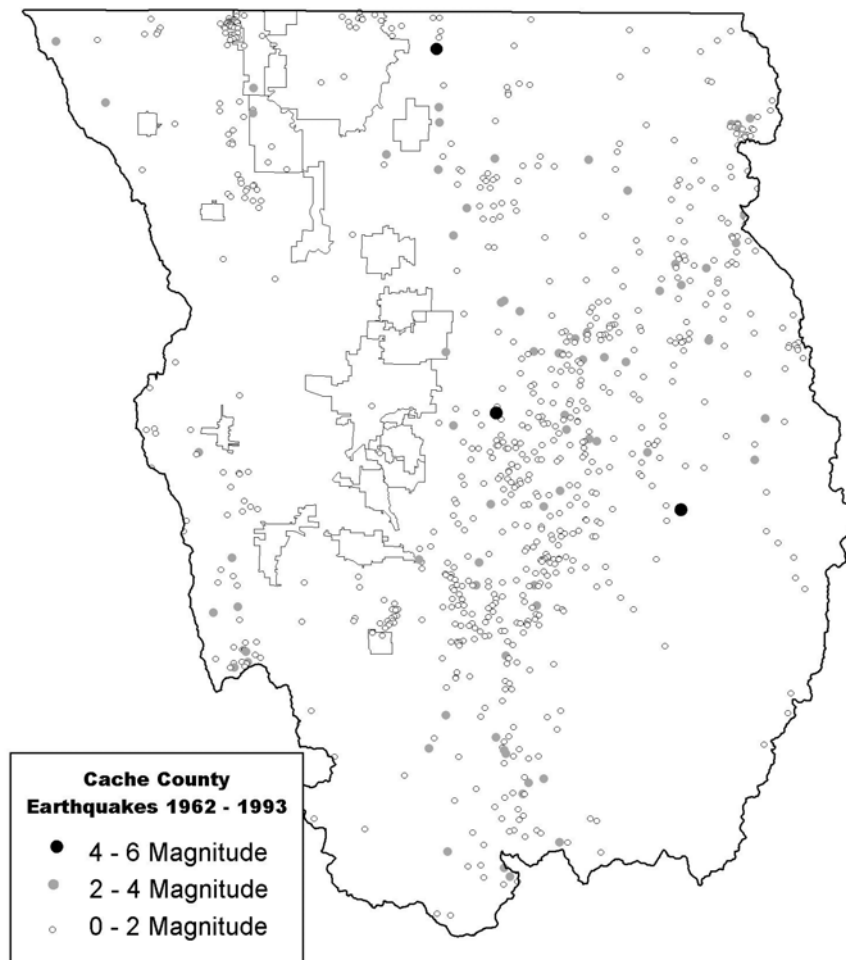


CACHE COUNTY EARTHQUAKES

Background

Cache County is located in a seismically active region within the Intermountain Seismic Belt. The most damaging earthquake in Utah's post European settlement history occurred in near Richmond City in Cache County. In 1962 a M_L 5.7 earthquake occurred near Richmond that damaged nearly three-fourths of the homes in the town. Damage to homes and building occurred in many surrounding areas of Cache Valley (Christenson, 1992). Some geologic evidence suggest that an earthquake of magnitude seven plus has occurred in the recent geologic past on the west cache fault zone. **See the "Earthquake Fault Zone" and "Liquefaction Potential" Map in the county annex map section.**

History of Earthquakes in Cache County



Cache County Earthquake Hazard Assessment Hazard Profile

Frequency	Low magnitude events occur frequently. Larger magnitude events are rare (although not necessarily on geologic scale).
Severity	Potentially Catastrophic
Location	Entire County with highest frequency in the Bear River Mountain Range. Surface fault ruptures are likely to occur in fault zones and liquefaction would impact large portions of the county.
Seasonal Pattern	None
Duration	A few minutes with potential aftershocks
Speed of Onset	No warning
Probability of Future Occurrences	Based on 1962-1993 data, there is a 29% chance every year of an earthquake of 3.0 magnitude or greater.

Three important fault zones have influence on Cache County. The East Cache Fault bounding the eastern portion of Cache Valley, the West Cache Fault bounding the western valley and the nearby Wasatch Fault. The majority of Cache County's population is located near the Eastern Cache Fault. Evidence points to the Temple Fork Fault as the most active in Cache County. Although miles away from the epicenter, this fault is thought to be associated with the 1962 Richmond Earthquake.

Areas in **Nibley**, western **Millville** and **Providence** and **River Heights** and southern **Logan City** have been identified with high liquefaction potential (see Cache County Liquefaction Map). In addition, much of the Bear River meander corridor has high liquefaction potential in the event of a Cache Valley earthquake (mostly un-developable river-bottom land).

Exposed risk to fault surface rupture exists in parts of upper Logan City, Millville, North Logan and Smithfield (See Cache County Fault Map).

Assessing Vulnerability: Identifying Assets & Estimating Losses

Table IV-39: Cache County Earthquake Risk (Liquefaction) Residential and Commercial					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Amalga Town	71	19	\$2,404,998		
Logan City	6,905	2,553	\$254,471,823	162	\$765,500/\$81,929
Nibley City	995	295	\$42,194,645	6	\$8,600/\$3,034
Providence City	81	19	\$1,997,362	9	\$9,400/\$4,551
River Heights City	59	26	\$3,873,180	17	\$21,300/\$8,597
Trenton Town	5	3	\$270,264		
Wellsville City	199	69	\$9,682,994		
Unincorporated	936	333	\$26,161,146	18	\$221,600/\$9,103
Population and Residential Development estimates are derived using 2000 Census data					
*2002 estimated total sales revenue (Census)					

Table IV-39: Cache County Earthquake Risk (Liquefaction) Residential and Commercial					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor's Office)					
Note: Communities not listed have no residential or commercial property identified in the hazard.					

Table IV-40: Cache County Earthquakes (Liquefaction) Other Facilities at Risk				
Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
Amalga Town		3.3miles/\$10,230,000	.198miles/\$9,491	
Cornish Town		0.8miles/\$2,480,000		.31miles/\$74,752
Lewiston City		2.4miles/\$7,440,000		1.87miles/\$540,922
Logan City	Logan So. Campus, Riverside & Wilson School,	1.7miles of highway/\$9,350,000 2708miles of 2 lane road/\$86,180,000		
Millville City		1.9miles/\$5,890,000		.68miles/\$163,972
Nibley City	Nibley School	6.5miles/\$20,150,000		.88miles/\$212,199
Providence City		1.5miles/\$4,340,000		
Trenton Town		1.1miles/\$3,410,000		
Wellsville City		4.7miles/& 14,570,000		.48miles/\$115,745
Unincorporated		1.6miles of highway/\$8,800,000 30.8 miles of 2 lane road/\$95,480,000	.98miles/\$46,975	1.22miles/\$294,185
See Appendix D for data sources and cost factors. Note: Jurisdictions not listed have no identified facilities at risk.				

Table IV-41: Cache County Earthquake Risk (Fault Zone) Residential and Commercial					
Jurisdiction Name	Population	Residential Development at Risk		Commercial Development at Risk (x 1000)	
		Units	Value	Units	Income*/Structures**
Logan City	43	18	\$3,046,896		
North Logan City	27	6	\$1,277,345		
Smithfield City	68	18	\$2,634,398		
Trenton Town	9	3	\$358,414		
Unincorporated	554	15	\$2,578,287		
Population and Residential Development estimates are derived using 2000 Census data *2002 estimated total sales revenue (Census) ** Based on average 2002 assessed commercial building value for Cache County (2002 State Tax Commission Report & Cache County Assessor's Office) Note: Communities not listed have no residential or commercial property identified in the hazard.					

Table IV-42: Cache County Earthquakes (Fault Zone) Other Facilities at Risk				
Jurisdiction Name	Critical Facilities	Roads	Power lines	Rail Lines
North Logan City			0.1miles/\$4,793	
Trenton Town				.17miles/\$40,993
Unincorporated			0.1miles 345Kv line/\$4,821 1.7miles 138Kv line/\$81,488	.31miles/\$74,752
See Appendix D for data sources and cost factors.				
Note: Jurisdictions not listed have no identified facilities at risk.				

Note: A 2001 study titled “Seismic-Hazard Mapping of the Central Cache Valley, Utah-A Digital Pilot Project” by McCalpin and Solomon provide next generation analysis and mapping of earthquake hazard mapping for the Newton, Smithfield, Wellsville and Logan 7.5-minute USGS quadrangles. The information contained in this report is certainly considered more accurate and the delineations more defensible; however for consistency this information was not used in the hazard analysis of this plan.

Cache County HAZUS Analysis

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates can be used by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The results of the model ran for Cache County simulates a 2,500 year event with a earthquake magnitude of 7.0.

Table IV-43: Cache County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)					
Timing	Sector	Level 1	Level 2	Level 3	Level 4
2 A.M	Commercial	6	2	0	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	4	1	0	0
	Industrial	10	3	0	1
	Residential	199	50	6	12
	Single Family	386	96	13	25
	Total	605	152	20	39
2 P.M.	Commercial	372	111	18	36
	Commuting	0	0	0	0
	Educational	206	61	10	20
	Hotels	1	0	0	0

Table IV-43: Cache County Human Casualty Estimates (HAZUS Model 7.0 Magnitude Earthquake)					
Timing	Sector	Level 1	Level 2	Level 3	Level 4
	Industrial	74	22	4	7
	Residential	11	2	0	0
	Single Family	59	15	2	4
	Total	723	212	35	68
5 P.M.	Commercial	337	100	17	32
	Commuting	0	0	0	0
	Educational	58	17	3	6
	Hotels	1	0	0	0
	Industrial	46	14	2	4
	Residential	76	19	2	5
	Single Family	152	38	5	10
	Total	670	188	30	57
Severity Level 1: Injuries will require medical attention buy hospitalization is not needed.					
Severity Level 2: Injuries will require hospitalization buy are not considered life-threatening.					
Severity Level 3: Injuries will require hospitalization and can become life threatening in not promptly treated.					
Severity Level 4: Victims are killed by the earthquake.					

Table IV-44: Cache County Building-Related Economic Loss Estimates in \$ Millions (HAZUS Model 7.0 Magnitude Earthquake)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses	Wage	0	1.46	25.12	1.24	1.42	29.24
	Capital-Related	0	.62	22.29	.75	.55	24.21
	Rental	16.79	17.43	12.73	.69	.69	48.32
	Relocation	1.55	.38	.58	.05	.20	2.76
	Subtotal	18.33	19.88	60.72	2.72	2.86	104.52
Capital Stock Loses	Structural	83.89	22.53	36.91	8.25	6.19	157.76
	Non-structural	294.13	109.22	98.06	27.94	20.95	550.29
	Content	70.51	22.50	43.39	17.87	10.22	164.50
	Inventory	0	0	1.44	2.57	.17	4.18
	Subtotal	448.52	154.26	179.80	56.64	37.52	876.74
	Total	466.86	174.14	240.52	59.36	40.39	981.26

Table IV-45: Cache County Transportation System Loss Estimates in \$ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
Highway	Segments	1,052	0
	Bridges	27	4
	Subtotal	1079	4
Railways	Segments	79	0
	Bridges	0	0

Table IV-45: Cache County Transportation System Loss Estimates in \$ Millions (HAZUS Model 7.0 Magnitude Earthquake)			
System	Component	Inventory Value	Economic Loss
	Subtotal	79	0
Airport	Facilities	5	2
	Runways	91	0
	Subtotal	96	2
	Total		

Table IV-46: Cache County Transportation System Loss Estimates in \$ Millions (HAZUS Model 7.0 Magnitude Earthquake)				
Classification	Total	Least Moderate Damage > 50%	Complete Damage > 50%	Functionality >50% at day 1
Hospitals	1	0	0	1
Schools	32	4	0	0
Police Stations	4	0	0	0
Fire Stations	7	0	0	0
On the day of the earthquake the model estimates that only 100% of the hospital beds in the county would be available for patient use.				

Table IV-47: Cache County Expected Building Damage by Occupancy (HAZUS Model 7.0 Magnitude Earthquake)										
	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	0	.01	0	.01	1	.01	0	.01	0	.02
Commercial	24	.69	42	.59	89	1	69	3	40	3
Education	1	.02	1	.01	2	.03	2	.07	1	.05
Government	0	.01	1	.01	1	.02	1	.04	1	.05
Industrial	4	.11	6	.08	14	.18	12	.45	7	.58
Religion	0	.01	1	.01	1	.02	1	.04	0	.04
Residential	279	8	624	9	899	12	602	23	291	25
Single Family	3,127	91	6,441	90	6,664	87	1,898	73	817	70
Total	3,435		7,116		7,672		2,585		1,158	

Assessing Vulnerability: Analyzing Development Trends

Development in Logan and North Logan has already encroached on areas that are susceptible to surface fault rupture on the Cache East Fault. Development pressure will increase for these towns as well as Providence, Millville and Richmond to build higher on the hillside and potentially build on active fault lines.

Some of the southwestern areas of Logan City have seen recent high growth. Much of this area has been identified as having high liquefaction potential in the event of a 5 plus earthquake.

Proposed annexation plans encompassing portions of the unincorporated College-Young Ward area also have identified problems with soils prone to liquefaction.



CACHE COUNTY DAM FAILURE

Background

There are 225 regulated dams located in Cache County. Most of these dams are small detention ponds, small agricultural reservoirs or livestock watering facilities and most pose a minimal threat to human safety or property.

Of the 225 regulated dams 215 are designated as “low hazard” by the State of Utah Division of Water Rights. As defined by state statute, low hazard dams are those dams which, if they fail, would cause minimal threat to human life, and economic losses would be minor or limited to damage sustained by the owner of the structure.

A total of 5 dams have been designated as “moderate hazard” by the State of Utah in Cache County. Moderate Hazard dams which, if they fail, have a low probability of causing loss of human life, but would cause appreciable property damage, including damage to public utilities.

The State of Utah has rated 5 dams in Cache County as “high hazard” which means that, if they fail, have a high probability of causing loss of human life or extensive economic loss, including damage to critical public utilities.

Dam failure inundation maps and emergency action plans for each of the high risk dams can be found on the Utah Division of Water Right’s website at: <http://waterrights.utah.gov/cgi-bin/damview.exe?Startup>.

History of Dam Failure in Cache County

No significant dam failures have occurred in Cache County.

Cache County Dam Failure Hazard Assessment Hazard Profile

Frequency	Rare
Severity	Potentially Catastrophic
Location	Areas down stream of failed dam.
Seasonal Pattern	Anytime. Highest risk in spring during snowmelt.
Duration	A few hours
Speed of Onset	No warning
Probability of Future Occurrences	Low

Assessing Vulnerability: Identifying Assets & Estimating Losses

Cutler Dam

Cutler Dam and reservoir lie in extreme western Cache County and about four miles east northeast of Fielding in Box Elder County. This facility has a hazard rating of high. The inundation area follows the Bear River flood plain first southwesterly and then south past Deweyville, Elwood, Honeyville, Bear River City and finally Corrine City before ending at the Great Salt Lake. Since the inundation area remains, for the most part, within the flood plain, threats the population and homes appears to be minimum.

Hyrum Dam

Hyrum Dam and Reservoir are located directly south of Hyrum City on the Little Bear River. The dam is rated as a high hazard facility and the inundation area flows westerly towards Wellsville five miles away, and then into Cutler Marsh.

Logan First Dam

This facility located near the mouth of Logan Canyon has a high hazard rating. The inundation area consists of most of the Island area, much of the landscape around the Logan River Golf Course and County Fairgrounds, and continuing west towards Cutler Reservoir. There is a significant population as well as large numbers of homes and businesses within the inundation area.

Porcupine Dam

Porcupine Dam is located about eight miles upriver from the town of Paradise on the east fork of the Little Bear River. The dam has a high hazard rating. There is no inundation map associated with this dam. This dam was recently drained and some reinforcement work performed.

Newton Dam

Newton dam was constructed by the Bureau of Reclamation on Clarkston Creek three miles north of the town of Newton. This facility has a high hazard rating. There is no inundation map associated with this dam.

Assessing Vulnerability: Analyzing Development Trends

Any new downstream development that is located in the floodplain increases the exposure to risk in terms of human life and property. Given the relatively low probability of catastrophic dam failures, most jurisdictions are unwilling to regulate development in dam failure inundation areas.